REMARKS

Claims 1, 4, 6, 8, 10, 12, 15, 17, 19, and 21 have been rejected under 35 U.S.C. §103(a) over *Fan et al* in view of *Kessler et al* further in view of *Mifune et al* further in view of *Herkstroeter*. The Examiner asserts that *Fan et al.* discloses a laser without a mirror that produces laser-like emission. *Fan et al* discloses a laser with a gain medium which includes a polymeric cholesteric liquid crystal disposed in a planar texture and frozen into a characteristic wavelength. This gain medium results in a medium feedback (DFB) which has basically the effect as external mirrors. Abstract, last two sentences; col. 1, lines 49-66. The term "feedback" means that the optical intensity fed back to the medium through the gain medium is done in the same way as accomplished by a mirror. The feedback in the *Fan et al* patent is provided by polymeric cholesteric liquid crystal. Abstract, last two sentences. The calculated reflectance of these crystals is approximately 100% which is about the same as a highly reflective mirror. FIG. 8B.

It should also be pointed out that *Fan et al* discloses the use of highly reflective coatings or mirrors. FIG. 6, nos. 61A and 62A; col. 10, line 59-62. *Fan et al* shows a highly reflective coating, FIG. 7, no. 72A; Col. 11, line 38-41. This highly reflective coating is a mirror. The reflective coatings and medium in *Fan et al* both function as reflective surfaces, and consequently are mirrors.

Applicant has invented a "mirrorless laser." *Fan et al* requires a mirror to achieve his results. Consequently the combination of *Fan* and the other references would not result in a "mirrorless laser" as Applicant has invented.

Applicant achieves laser-like emissions without either a mirror or utilizing the distributed feedback effect. Applicant achieves these laser like emission by the creation of macroscopic dipoles arising from coherent interactions of photo-excited species in the presence of an intense optical field. Applicant has discovered that certain organic molecular having large ground-state and excited-state dipole moments produce these emissions. Specification page 4, line 15-19. Hence, it is believed that Applicant achieves these laser like emissions by using organic molecular salt having large dipole moments in the ground excited state.

The combination of *Fan et al, Kessler et al, Mifune et al,* and *Herskstroeter* would not result in Applicant's mirrorless laser. This combination would have the mirror disclosed in *Fan et al.*

In an attempt to show that the Applicant's invention is obvious, the Examiner combines *Fan et al* and three other patents. One of these patents is *Kessler et al.* It should be pointed out that all of the claims in the application (claims 1-22) claim a "mirrorless laser." The Examiner states that *Kessler et al* discloses a laser "without external mirrors." Office Action page 3, line 6-7. However, the optical cavity 14 of FIG. 1 of *Kessler et al* includes reflectors 20 and 22. Col. 6, line 4-6. Applicant's invention does not require the use of any external mirrors or a mirror in active medium Applicant's invention is truly a "mirrorless laser." This is clearly shown in Fig. 1 of Applicant's drawings. *Kessler et al* make clear in other places in their patent that mirrors are required. For example, the Abstract states that the "host is aligned within a lasing cavity." It is well recognized in the art of lasers that a cavity means that there are two mirrors forming the cavity.

Thus, the combination of *Fan et al* and *Kessler et al* does not result in a "mirrorless laser." As pointed out above, *Kessler et al* does not disclose a mirrorless laser, but rather requires mirrors. This is also true of *Fan et al* as pointed out above. Thus, the combination of these two patents that both require mirrors would not result in a mirrorless laser. One *Fan et al* does not show a mirrorless laser. There is nothing to suggest that a mirrorless laser would result from combining *Fan et al* and *Kessler et al* since *Kessler et al* teaches that two mirrors are required for his laser. There is nothing in either *Fan et al* or *Kessler et al* to suggest that the mirrors could be dispensed with. Of course, *Fan et al* does not teach or suggest a laser without mirrors as pointed out above.

The Examiner has asserted that it would be obvious to combine the *Kessler et al* teaching of emitting pulses shorter than 100 picoseconds of the excitation pulses and having the pulse-energy of less than a microjoule. This rejection is only applicable to claims 8, 10, 19 and 21. Pulses this short are not disclosed in *Fan et al.* There is nothing to suggest in *Kessler et al* that these short pulses would work the laser disclosed by *Fan et al.*

The Examiner combines *Kessler et al* and *Fan et al* with *Mifune et al* and *Herskstroeter.* The Examiner asserts that it would be obvious to provide *Kessler et al* with the alkyl group formula taught or suggested by *Mifune et al* and *Herskstroeter.* The compounds in *Mifune et al* and *Herkstroeter et al* are very different from the compounds disclosed in *Kessler et al* and there is

nothing to suggest the substitution of the alkyl group in the general equation of *Kessler et al.* Furthermore, *Mifune et al* simply discloses "photographic light-sensitive material." Abstract, line 1. *Mifune et al* does not appear to have any relevancy to lasers. *Herkstroeter et al* discloses solutions useful in dye lasers but does not disclose that these solutions can be used to produce mirrorless emissions. There is no motivation to suggest the substitution of the alkyl group as taught or suggested by *Mifune et al* and *Herkstroeter* and *Kessler et al.* More importantly these four references of *Fan et al, Kessler et al, Mifune et al* and *Herkstroeter* do not result in Applicant's invention. Consequently these claims are not obvious and are clearly patentable.

The Examiner has rejected claims 2 and 13 on the basis of the above four patents in combination with *Urata et al.* Even with this combination, one does not have a mirrorless laser. Furthermore, there is no motivation to combine *Urata* with these four patents.

Claims 3 and 14 have been rejected on the basis of the four patents and *Carrig et al. Carrig et al* does disclose the DAST formula. Combining these references with *Kessler et al* does not result in Applicant's mirrorless laser as *Kessler et al* requires two mirrors.

Claims 5 and 16 have been rejected on the basis of these four references and *Thakur*. The combination of references does not result in a mirrorless laser. *Kessler et al* requires two mirrors as stated above.

Claims 7 and 18 have been rejected on the basis of the same references in view of *Ashkin et al* who discloses the use of a matrix of polymethylmethacrylate. Col. 7, lines 1-6. This combination also does not result in Applicant's invention as *Kessler et at* requires the use of two mirrors.

Claims 9, 11, 20, and 22 have been rejected on the basis of these same references in view of *Wada et al. Wada et al* discloses that the optical part of an optical thin film may be potassium dihyrogenphosphate or ß-barium borate. Col. 3, lines 37-43.. Again, this combination does not disclose a mirrorless laser.

Applicant has invented a mirrorless laser using the dipolar organic molecular salts defined in the claims. The dipolar organic molecular salt used by Applicant only requires a very low threshold pump pulse energy (less than 1 μJ, and has a high energy conversion efficiency (e.g. 40%). Specification page 16 lines 12-14. Applicant has invented a laser that produces "mirrorless" laser emissions. It was unexpected that these dipolar organic molecular salts could produce highly

efficient laser emissions at low thresholds without the use of external or internal mirrors. These laser emissions are produced where the active material is contained in a typical dye cell. Specification, Page 11, lines 8-9. The active media used in conventional lasers must have a very high photoluminescence quantum efficiency. The most widely used laser dyes for conventional lasers have high photoluminescence efficiencies. Quite unexpectedly, Applicant's dipolar organic molecular salts produce mirrorless laser emissions with a very high efficiency at low threshold excitation despite relatively low photoluminescence quantum efficiencies. Specification, Page 11, line 21 to Page 12, line 4. Applicant's laser is very inexpensive to produce and is very useful for short laser pulses. Specification, Page 17 line 6-7.

CONCLUSION

In conclusion, it is believed that all of the claims are patentable as the combination of all the prior art does not result in a "mirrorless laser." An early allowance of all the claims is respectfully requested. If the Examiner wishes to discuss this Application with the undersigned, please contact the undersigned at the telephone number listed below.

Respectfully submitted,

Harold L. Marquis, Reg. No. 20,594

THOMAS, KAYDEN,
HORSTEMEYER & RISLEY, L.L.P.
Suite 1750
100 Galleria Parkway N.W.
Atlanta, Georgia 30339
(770) 933-9500